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Vol. 3, No. 2 FEBRUARY, 1921 Old Series Vol. xix, No. 2

*The* Journal *of* Orthopædic Surgery

# JOINT RANGE.

WILTON H. ROBINSON, M. D.
PITTSBURG.

In the movement of an extremity the two most important factors involved are the power or amount of force present and the amplitude or range of motion; the former being indicative of the amount of function present in the muscles crossing the joint and the latter of the amount of motion between the joint surfaces.

It is desirable in the progress of a given case of joint disability, to be able to measure, in some simple and practical manner, one or both of these factors. To measure power, or the amount of force present in muscles crossing a joint, the methods devised by Drs. Lovett and Martin (1.) are probably the soundest. While conceived, primarily, for use in measuring muscle function in poliomyelitis, experience has shown that the principles involved hold in any case of muscular disability.

It is not within the province of this article to detail the methods of measuring power. We are concerned only with the measurement of the amplitude or range of motion, and the reader is urged, for the sake of clarity of thought, not to confuse in his mind the two factors. In the former we speak in terms of pounds moved under fixed conditions, while in the latter we speak in terms of degrees of a circle traversed by the distal constituant member of a joint.

To take the measurement of the range of motion, a special instrument of some sort is required and many have been devised, among which may be mentioned the following:

The Arthro-Dyanamoter of C. F. Sonntag, consists of a frame work to carry the member under observation, a series

of pulleys and weights for measuring power, provision being made for measuring range of motion on a protractor scale appropriately arranged and fastened in relation to the joint. It is quite large and there are numerous attachments. Fortesque Fox has designed a series of five instruments, four of which he calls respectively the Fleximeter for the wrist and fingers, for the ankle, for the knee and for the elbow. Those for the wrist, fingers and ankle may be used by being laid on the back of the joint to be measured, while those for the knee and elbow must be strapped on. The essential principal of these instruments is an indicating arm acting in relation to and registering against a protractor scale. In addition to the four instruments mentioned he has also devised what he calls a Torsionmeter to measure pronation and supination. This instrument consists of a base board to which is attached, at its lower end a protractor scale upright, and at right angles to the axis of the forearm when it is strapped in position for observation. Attached at the axis of the scale is a handle which actuates the indicating finger against the scale as the hand is turned. It is one of the best instruments for measuring supination and pronation, but it is unfortunate that it has been so named. We should not think of supination and pronation as being essentially torsion movements. This will be made clear later when speaking of the movements of particular joints. Dr. H. C. Gifford (2) has designed a set of instruments for measuring the range of joint movements; there are four instruments in the set and the principal of the protractor is used in all. In addition to the above, an instrument designed by W. Wilbraham Falconer has recently appeared on the market. It is a device consisting of a circular metal box carrying a protractor scale on the front against which registers a pointer actuated by a counter weight inside the metal box. It is to be strapped to the member to be measured and the range of motion read as the part is elevated.

The instruments mentioned above are only a few of the many evolved for measuring joint range. They all have some disadvantage. Either they are too large and complicated to be carried about or their construction is such that they are not adaptable to all joints. The original instrument was a protractor modified so that its use on the extremities was

facilitated. It consisted essentially of two arms; to the end of one was attached a protractor scale, while one end of the other arm was shaped to a pointer; these arms were connected at the axis of the scale so that the pointer registered against the scale. For general utility this type of instrument fills all requirements. With only a moderate amount of care in placing the instrument and taking the reading, as great accuracy is attained as with a much more complicated apparatus. In addition it may be used in other ways than measuring joint range, as for example measuring the amount of angular deformity of a fracture on the X-ray plate which is often a very important consideration in the treatment, particularly in fracture of the neck of the femur. It might also be mentioned, in passing, that such an instrument is occasionally very useful in brace designing to establish on the drawing definite angles.

In order to provide an instrument for general use that might be carried in the pocket and thus be always available just as is the pocket tape, the writer suggests an instrument made of metal and of the protractor type with the arms jointed to fold on themselves; this reduces the length of the instrument to less than six inches when it is folded and adds greatly to convenience. (Fig. 1) The straps shown are for the purpose of attaching the instrument to the limb when so desired. They are provided with little loops to carry the arms of the instrument.

In taking observations with this or any other instrument of the protractor type it is necessary to establish a base line and the axis of motion for each joint. (Figs. 2 to 16). The base line is in the axis of the limb and crosses the axis of motion at a right angle. The reading is taken by placing the instrument so that its little axis pin is over one end of the axis of motion of the joint under observation, the upper arm corresponding as nearly as possible to the long axis of the bone above the joint and the other arm in the same relationship to the bone or bones below; the upper arm of the instrument being held firmly in position, either by the hand or the straps, the lower bone member of the joint is moved in one direction to its full extent and the reading taken on the scale; motion is then made in the same way in the opposite direction and the reading again taken; thus we have the number of degrees of

motion allowed and the relationship of the extreme positions to the axis of the proximal bone; for example, the ankle joint has its axis of motion directly in line with, and about ½ inch below the internal malleolus, the degree of dorsal flexion being to 45 degrees on the axis of the leg and the degree of plantar flexion, or extension, to 135 degrees on the same axis or a range of motion of 90 degrees. For those motions having their axis in the long diameter of a limb we take the measurement at the end of the limb except for shoulder rotation which we

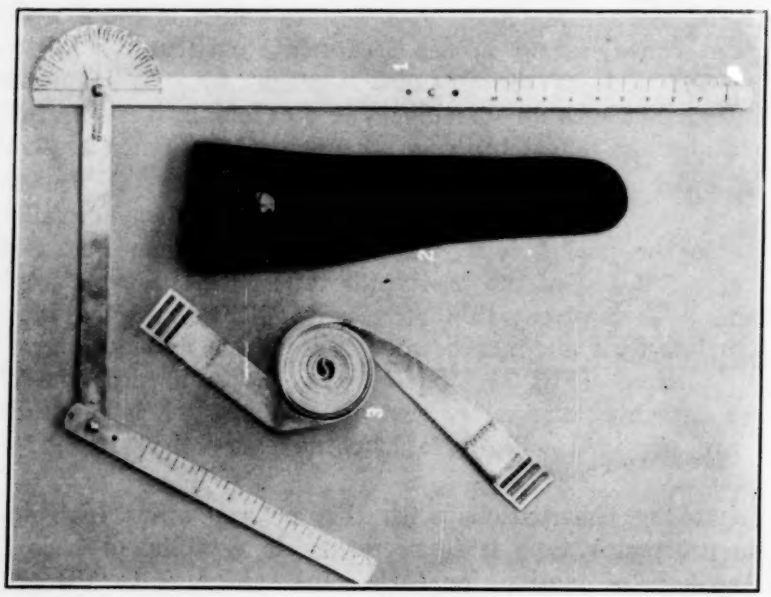

Figure 1.

can best estimate at the flexed elbow; pronation and supination is measured at the closed fist and femur rotation at the sole of the foot with the leg fully extended at the knee.

It is desirable to adopt some sort of a provisional standard of the normal range of motion for each joint. As indicated above it is possible to select certain motions and by measuring their amplitude in a definite manner to attain a certain degree of accuracy. As the range of motion will vary in different subjects, as from the amount of soft tissues over the joint or from other causes, it is best to take as the standard for any

joint the range of motion of the corresponding joint on the opposite side of the body, providing it is present and is not also disabled. In order to provide some sort of a gross standard for the normal range of joint motion the following brief descriptions of certain essential movements is given. Most of the cuts to illustrate the movements described were worked out by C. F. Sonntag and were used by him in case recording at Sheperd's Bush Military Hospital during the war. Some of them have been slightly altered by the writer to conform to the range of motion as elicited during experiments and a few additional cuts drawn to show additional movements.

*Movements at the Shoulder Joint.* The arm is attached to the body at the shoulder through the medium of the shoulder girdle, which may be said to be in the form of an arch having but one point of direct, ligamentous attachment, to the skeleton, namely at the inner end of the clavicle, or what may be called the anterior end of the arch; the posterior end of the arch is the scapula, lying between planes of, and actuated by certain muscles of the back. The principal motion of the scapula is one of rotation in a plane corresponding to its flat surface on, roughly speaking an antero-posterior axis near the clavicular attachment of the coraco-clavicular ligament. At the outermost portion of the shoulder girdle, corresponding to the place for the keystone of the arch, to carry the simile through, is the glenoid cavity receiving the head of the humerus, which is held to the shoulder girdle by a very loose capsular ligament, which allows very free motion of the humerus. The movement of the arm on the body is in all directions, forward, backward, abduction, adduction, rotation and circumduction. From a position in which the arm hangs at the side with its axis corresponding to the long axis of the body, the arm may be made to move backwards through an arc 45 degrees, and forward through an arc of 180 degrees, or pointing directly upward. From the same position it may be moved in the direction of abduction through an arc of 180 degrees also pointing directly upward. Of the two latter motions it may be said that the first 90 degrees represent principally motion at the humero-glenoid articulation, but that the latter part of the movement involves greater scapular movement, though in the normal individual the entire motion is compound, that is, there is motion both at the humero-

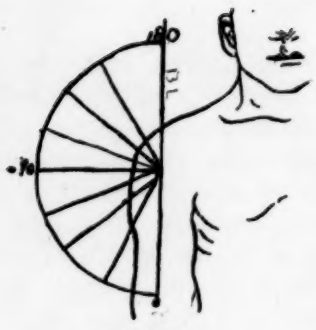


Fig. 2.

Fig. 3

Fig. 4.

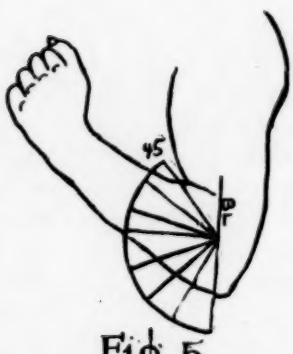


Fig. 5

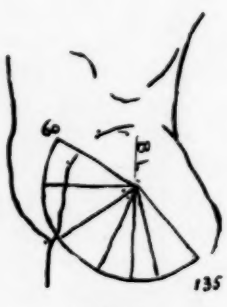


Fig. 6

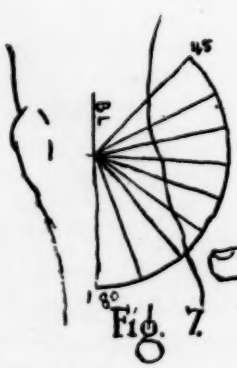


Fig. 7

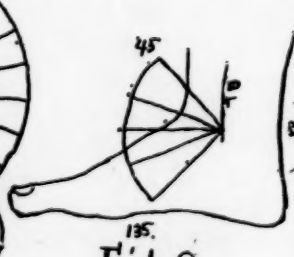


Fig. 8

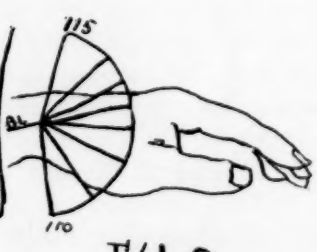


Fig. 9.

Fig. 2. Abduction of arm at shoulder.
Fig. 3. Abduction and adduction of leg at hip.
Fig. 4. Forward and backward movement of arm at shoulder.
Fig. 5. Flexion of elbow.
Fig. 6. Flexion and extension of leg at hip.
Fig. 7. Flexion of knee.
Fig. 8. Flexion and extension of foot at ankle.
Fig. 9. Flexion and extension of hand at wrist.

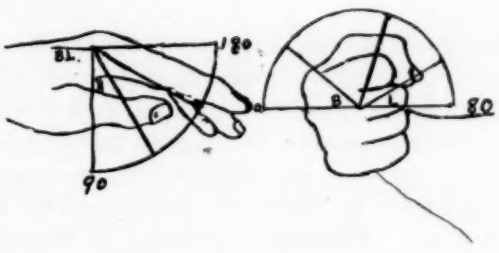


Fig. 10.



Fig. 11.

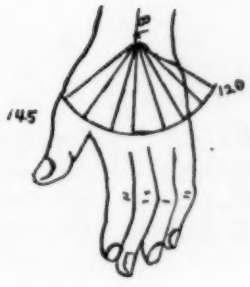


Fig. 12.

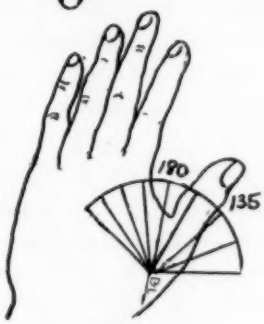


Fig. 13.

Fig. 14.

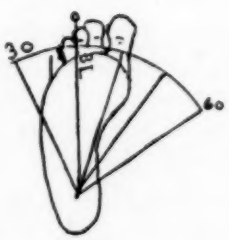


Fig. 15.

Fig. 16.

Fig. 10. Flexion of fingers at metacarpo-phalangeal joint.
Fig. 11. Supination and pronation.
Fig. 12. Radial and ulnar flexion at wrist.
Fig. 13. Abduction and adduction of thumb.
Fig. 14. Inversion and eversion of foot.
Fig. 15. Rotation of leg at hip.
Fig. 16. Abduction and adduction of foot at mid-tarsal joint.

Note: Base line is marked B. L.

glenoid joint and on the part of the scapula throughout the upward motion of the arm. To estimate the first part of this upward movement of the arm the scapula must be held firmly. With the arm abducted to 90 degrees and the fingers pointing upward, it will be seen that there is possible forward rotation of 90 degrees, which can be seen as the hand is allowed to fall forward. In this position an additional movement downward of the forearm of 100 degrees or more is possible by movement of the scapula. This movement of rotation of the head of the humerus can also be demonstrated with the arm in the hanging position and the forearm pointing directly forward, in this case, however, the rotation of the head of the humerus is inward. The measurement of circumduction is not recommended because it is not a simple movement and is not considered to be of great clinical help.

*Movement at the Elbow Joint.* The motion of the forearm on the upper arm is from full extension or 180 degrees to flexion of from 55 to 45 degrees. There is normally no lateral motion. The superior radio-ulnar articulation is usually thought of as being part of the elbow joint. We should dissociate them in our minds and thereby greatly simplify our examinations of this region.

*Movement of Supination and Pronation.* From a position of full supination or with the palm directly upward the hand may be turned inward and downward through an arc of 180 degrees until the palm is directly downward. Any extension of this movement beyond that mentioned represents rotation of the humerus. The mechanics of pronation may be described as a rotation of the head of the radius (pivoting) inward at the superior radio-ulnar joint: there is of course just as much inward rotation at the wrist or inferior radio-ulnar joint and in addition the lower end of the radius describes an arc, at first upward and inward and then downward and inward, about an axis in the lower extremity of the ulna. From this it will be seen that motion at the lower end of the radius is more of a hinge than a pivot joint as usually described. The ulna is absolutely neutral in pronation or supination, any doubt of this may be dispelled by the examination of an elbow joint on the skeleton when it may be seen that the ulna is adequately prevented from any motion except flexion and extension on

the upper arm. The mechanics of supination exactly reverses the process of pronation.

*Movement at the Wrist Joint.* Disregarding pronation and supination the movements at the wrist joint are flexion and extension, abduction and adduction, or what for the last two are much better terms, radial and ulnar flexion; in addition there is, through a combination of the movements mentioned, circumduction. Flexion is possible to 110 degrees on an axis through the proximal row of carpal bones at about the level of the pisiform. The hand may actually be flexed to 90 degrees on the forearm but the range thus attained is not in the wrist but rather from movement of the carpal bones. Extension is possible to 115 degrees on the same axis as flexion. Radial flexion is possible to 145 degrees on an axis through the proximal edge of the semilunar bone, while ulnar flexion is possible to 120 degrees on the same axis.

*Movement in the Carpus.* Is difficult to measure, although about 15 to 20 degrees may be demonstrated by forcing the hand into extreme flexion after the maximum has been attained from the wrist joint.

*Movements of the Fingers.* The movement of the fingers at the metacarpo-phalangeal joint are flexion to 90 degrees, radial and ulnar flexion of varying amounts and circumduction. The phalangeal joints should allow flexion until fingers close on themselves.

*Movements of the Thumb.* The thumb is capable of abduction, adduction, flexion, extension and circumduction. The metacarpal bone of the thumb articulating with the trapezium adducts to 180 degrees or to a straight line to the forearm and abducts to about 135 degrees. Flexion at the metacarpo-phalangeal joint is from full extension (180 degrees) to 120 degrees. It will be observed that full adduction, that is with the thumb across the palm is only attained through the flexion movement at the metacarpo-phalangeal joint.

*Movement at the Hip Joint.* The movements of the femur at the hip joint are flexion, extension, abduction, adduction, rotation and circumduction. All movements may be more free in women than in men. Flexion is only limited by contact of the thigh with the abdomen a relation of from 60 to 50 de-

grees to a line in the long axis of the trunk. Extension, limited by the ilio-femoral ligament and the front of the capsule is about 135 degrees. Adduction is limited, strictly speaking, by contact with the opposite leg but with slight flexion and rotation may be carried to about 135 degrees. Abduction, limited by the outer band of the ilio-femoral ligament, the ilio-trochanteric ligament and the outer part of the capsular ligament is to about 50 degrees. Rotation outward is limited by the outer band of the ilio-femoral ligament and inward by the ischio-capsular ligament and back of the capsule. The range of this movement is about 90 degrees. The measurement should be made with the patient recumbent and the toes pointing directly upward when it may be observed that by turning the knee outward the forefoot may be made to describe an arc of 60 degrees outward and inward of 30 degrees, both measurements, of course, being from the perpendicular.

*Movement at the Knee Joint.* At the knee joint there is possible but one motion namely flexion of the lower leg on the thigh from full extension of 180 degrees to full flexion of 45 degrees on the thigh. This is not a simple hinge movement because the head of the tibia makes an excursion through an arc of a circle in a backward and downward direction as the leg flexes.

*Movement at the Ankle Joint.* At the ankle joint the foot flexes dorsally to 45 degrees on the line of the leg and plantar flexes to 135 degrees on the same line. There is no lateral motion normally in the ankle joint except by some spreading outward of the lower end of the fibula, which of course it is best to disregard in measuring.

*Movement at the Mid-tarsal Joint.* The mid-tarsal joint is made up of two articulations; the astragalo-cuboid and calcaneo-cuboid. The principal motion permitted is of the forefoot in the direction of adduction and abduction on a vertical axis; motion of the forefoot is also possible on an antero-posterior axis in the direction of inversion and eversion and on a transverse axis allowing flexion and extension. Careful consideration of the movements at the mid-tarsal joint is of prime importance in the examination of disabilities of the foot. In estimating the amount of flexion at this joint the ankle must be held immobile.

## CONCLUSION.

While the careful methodical measurement of the amplitude or range of motion of joints offers an opportunity to obtain valuable clinical data, it is even more valuable to record the progress toward complete recovery of certain types of joint disability. Taken in connection with measurement of muscle power the usefulness of the proceedure is, in certain cases, increased.

A simple type of instrument should be used. It is not possible in the ordinary hospital to have a mensuration department and therefore the more cumbersome instruments are not recommended.

As all bones move from the joint on an arc of a circle we may accept measurements reading in degrees as recorded on the ordinary quadrant or protractor scale, but it would seem most desirable that all observers use the same method of taking and recording their measurements, and this necessitates the use of a constant base line for each joint, and that the angle be taken in relation to this base line. Doubtless no better base line can be found than the long axis of the proximal bone member of the joint under observation. For the shoulder and hip we use a line parallel to the long axis of the body and stopping at the anterior end of the axis of the motion. For rotation of the humerus and femur we use a vertical, in the first at the flexed (90 degrees) elbow and in the second at the sole of the foot. For supination and pronation the most convenient base line is a horizontal line across the closed fist with the hand in full supination.

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# STOFFEL'S OPERATION FOR SPASTIC PARALYSIS, WITH REPORT OF THIRTY-TWO CASES.

A. BRUCE GILL, A. B., M. D., PHILADELPHIA

*Read at Toronto at the 1920 Meeting of the American Orthopedic Association.*

In an article on "The Surgery of Spastic Paralysis," Annals of Surgery, May 1918, Volume 67, Number 5, I discussed briefly the surgical procedures employed in the treatment of spastic paralysis, and made a preliminary report of cases operated on by the Stoffel method of peripheral neurectomy of motor nerves. The reader should study Adolf Stoffel's paper "The Treatment of Spastic Contractures" which appeared in the American Journal of Orthopaedic Surgery, May 1913, Volume 10, Number 4. I performed my first Stoffel operation in February, 1914, at the suggestion of Dr. A. P. C. Ashhurst, whose assistant I then was at the Orthopaedic and the Episcopal Hospitals. Since that time I have operated on thirty-two patients, in whom partial neurectomy has been performed thirty-four times on the popliteal nerve, twenty-seven times on the obturator nerve, six times on the median nerve, and five times on the sciatic nerve—a total of seventy-two operations. In this present paper I shall report these cases in detail, and shall discuss the Stoffel operation and consider the position which it should take in the treatment of spastic paralysis.

It seems best to consider this subject in the manner in which the orthopaedic surgeon confronts it in his daily experience. I shall not deal with the causes of spastic paralysis nor with the various forms it assumes, except so far as they are related to the treatment.

## Clinical Varieties

The patient presents evidences of spasticity of the muscles of one or more extremities. The muscle reflexes are exaggerated. The stronger groups of muscles usually have overcome by constant tension the feebler groups, and have produced a certain state of deformity of the member. A condition of apparent contracture of the stronger muscles is present. In the upper extrem-

ity this is manifested in flexion of the elbow, the wrist, and the fingers, and in pronation of the forearm. In the lower extremity it is manifested in the adduction of the thighs, the flexion of the knees, and the plantar flexion of the feet. The amount of spasticity and the degree of contracture vary widely in different cases. In some, active motion of the affected member is entirely absent, e. g., the foot is fixed in extreme plantar flexion, so that the patient is unable to move it. In others, the contracture is more moderate, and the patient has partial active motion, e. g., he may be able to dorsiflex his foot to a right angle, and plantarflex it to the normal limit. In still another group of cases active motion may be almost or altogether complete, but the patient has difficulty in originating and carrying out the motions, e. g., the hand and fingers may be held usually in a position of flexion, but the patient is able, after some delay, and possibly with the assistance of his other hand, to extend his wrist and fingers practically to the normal extent, and actively to flex them again. In such cases no contracture is present, but the cerebral control of the member is lessened. Motions are delayed and slow and are not always to be depended upon when desired.

Many of the patients are seen by the surgeon before they have learned to walk. Others may be able to walk with considerable difficulty when assisted by a supporting hand. Others may walk fairly well but usually with a certain degree of adductor, hamstring, and Achillis contracture, so that the knees strike together or cross each other and are kept in partial flexion and the heels do not touch the ground. In a fairly large proportion of cases these patients are mentally deficient, and some are even completely idiotic. They are nearly always slow in learning to talk and to walk. Not infrequently cases are met which have reached the age of puberty without being able to do either.

The tendency among orthopaedic surgeons has frequently been to consider these backward children as more or less hopeless, and to decline to undertake treatment because of the length of time and the amount of attention that are required, and because of the discouraging results that are often obtained; but certainly if no orthopaedic measures are employed these needy cases will not improve of themselves. It is unquestionable that many cases can be very greatly helped, and that some improvement can be secured in almost all. In a low grade idiot improvement may in-

deed be insufficient to justify a long course of treatment. But there are many cases on the border-line who should be given the advantage of reasonable doubt. If it is possible for the surgeon to enable these individuals to walk, a great deal will have been accomplished in adding to their usefulness and to the comfort of their families.

## Preliminary Treatment

The object of all treatment is to secure restoration or improvement of function. If a patient is unable to walk the aim of the surgeon is to enable him to do so, even by the use of crutches and braces if necessary. If he is able to walk with difficulty the object is to improve his locomotion. If the disability is in the upper extremity treatment is for the purpose primarily of securing better function of the hand so that the patient may have an enlarged field of usefulness in life and, secondarily, of improving the appearance of the hand and of relieving painful or uncomfortable spasm of the muscles.

In examining these cases the surgeon should note the extent of the spastic paralysis, the comparative difference in the strength of antagonistic muscles or groups of muscles, the degree of contracture and its condition as to whether it is permanent or temporary, the amount of disability in the member, the mentality of the patient, and his social condition. One shquld know also whether or not the patient has been neglected or whether he has received intelligent treatment. The surgeon may then outline the course of treatment which may be necessary to arrive at the definite end of return or improvement of function.

If the patient can remain under the care of the surgeon as long as is desired, a preliminary course of treatment should be undertaken before any operative procedure is considered. If the circumstances are such that whatever can be done should be done quickly, then immediate operation may be performed. If a patient has already had careful treatment which has been largely in the way of prophylaxis to prevent deformity, the preliminary treatment may be dispensed with. This treatment is undertaken for the purpose of improving function as far as possible before surgical operation is resorted to, and to enable the surgeon the better to decide what operation, if any, may be required. If the patient has a marked talipes equinus so that he stands or walks

upon his toes, and has no active dorsiflexion of the foot, the surgeon may be unable at once to decide what operation may be necessary or how far the operation should go in order to secure a good result. The anterior muscles of the leg appear to be completely paralyzed; but if, with or without an anesthetic, the foot is dorsiflexed and the knee extended and the extremity put in plaster-of-Paris in an overcorrected position for a period of four to six weeks, it may be found at the end of this time that the anterior leg muscles have recovered considerable power, and that the patient has considerable active dorsal and plantar flexion of the foot. If this improvement is maintained by means of a brace and if massage and painstaking active exercises are instituted, with possibly the use of the Galvanic current, still further improvement may be secured. It may be found that no operation is necessary. If, however, the foot shows marked tendency to return to its former position of equinus, or if sufficient improvement has not taken place the surgeon is then in a position to note to what extent the Stoffel operation should be carried. The same observation holds true for deformity of the upper extremity.

It must be borne in mind that in spastic paralysis the element of spasticity far overshadows the element of paralysis. Indeed, a real or complete paralysis is very rarely present. All muscles are spastic, but the strong muscles have overcome their weaker antagonists, and produced a deformity. The weaker muscles are thus still further weakened by over-stretching and by being placed in a bad mechanical position; and the stronger muscles become still more spastic by the approximation of their points of origin and insertion. One object of all methods of treatment including the Stoffel operation is simply to secure more or less muscle balance, so that the weaker muscles or muscle groups may not be overcome by more powerful antagonists, but may be able to exercise their proper function. In normal individuals the play between antagonistic groups of muscles is under cerebral control, but in cases of spastic paralysis this control has been more or less lost. When the muscle balance has been approximately restored the patient may regain almost normal active motion of the member, or he may secure but feeble and delayed motion. In still other cases the amount of active motion secured may be very slight, but the patient is benefitted by the removal of the deformity and the consequent improvement of function. In

addition, the cosmetic appearance has been greatly improved, a consideration of no mean value in the upper extremity.

If the surgeon by means of the Stoffel operation has secured more or less muscle equilibrium he must not consider his task ended, for a long and careful course of after-treatment is necessary. The weaker muscles which have so long been at a disadvantage must be carefully strengthened and trained. For this purpose massage, Galvanic electric current, manipulation of the joints, and above all careful active exercises must be carried out. Braces may be necessary to prevent relapse. It may be found that too little resection of the nerves has been done, and a second operation will be necessary. Of course, when the mentality of the patient is fair or good the improvement will be much more rapid. Idiotic children may be unable to assist in any way and the surgeon may have to be content with the elimination of the deformities present. Such patients may possibly learn to walk with the use of braces and by the employment of an apparatus such as a wheel-crutch.

## Purpose of the Stoffel Operation

We consider now the operation in itself. As has been stated the deformity in the patient is due to muscle unbalance. The disability is due in part to the deformity and in part to the spasticity and greater or less interference with normal cerebral control of the muscles. The operation aims to remove the deformity and as well to break the vicious circle of the peripheral arc, which produces the spasticity. In my article on spastic paralysis, previously referred to, I have described the establishment of this vicious circle and the means employed to break it. I shall not discuss it here; it is sufficient to say that the Stoffel operation does more or less cut this circle and relieve to a greater or less extent the spasticity. When this has been accomplished it is found that the brain in most cases is able to exercise more or less control over the peripheral arc. Therefore, we may say that the object of the Stoffel operation is twofold; to remove deformity, i. e., contracture, and to secure better cerebral control of the members. The operation consists in the excision of a portion of the nerve supply to the strong and contractured muscles. This produces a partial or complete paralysis of these muscles. The amount of paralysis or weakening of a muscle group should be sufficient to

cause a muscle balance between this group and the antagonistic muscles. If this be overdone the antagonistic muscles may in turn overcome those which were formerly the stronger and produce a deformity opposite to the original one. Therefore, the chief element in the operation is the matter of judgment as to how large a portion of the nerve supply to any muscle or any group of muscles as a whole should be excised. This is somewhat a matter of experience; and until this experience has been gained the surgeon should err by doing too little rather than by doing too much, as he can always return to resect more nerves if necessary, but he cannot replace nerves already resected. Let me here emphasize again the importance of preliminary treatment to enable the surgeon to judge how far he should proceed with his nerve resection.

## Technic of the Operation

Let us now consider the method of operation upon the various nerves. First, the median nerve. The common deformity in the upper extremity has been already described. I have not found it necessary to operate for flexion contracture at the elbow. But it is possible in certain cases that a portion of the nerve supply to the biceps muscle might require resection. The median nerve is exposed in the bend of the elbow. The incision need not be more than two inches in length. The nerve is freed from surrounding tissue, and partially retracted out of the wound, and supported on a grooved director or a haemostat, placed transversely. On the anterior aspect of the median nerve adjacent to the biceps muscle is to be seen a nerve tract or cord. A portion of this separates itself from the median nerve and goes directly to the superficial head of the pronator radii teres. This is the first branch to leave the median nerve in the flexure of the elbow. This branch should be entirely resected for a distance of several inches. It can be cut off below near the point where it enters the muscle, and can be dissected up from the median nerve any desired distance. The remainder of the tract already described consists of the nerves to the flexor carpi radialis, the palmaris longus, and the deep head of the pronator radii teres. These bundles of nerves are to be freed from the remainder of the median nerve and from one another and to be tested by the electrode. In severe cases of pronation and flexion contracture all of these nerves should be excised. In less

severe contracture one may split the nerve to each muscle and may resect approximately one-half to three-fourths of it. The nerve to the pronator quadratus is to be found in the dorsal portion of the median nerve. Usually it should be left intact, but in very severe cases it may be resected. In none of my cases have I found this resection necessary. The median nerve is now further separated into its constituent bundles. It will be found that the nerve supply to the flexors of the fingers is on the dorsal and ulnar aspect. These bundles should be freed from the remainder of the median nerve, separated from each other and tested by the electric current. Such portion of them may be removed as is demanded by the severity of the contracture. The remainder of the median nerve consists of the sensory tracts, and of the motor nerves for certain intrinsic muscles of the hand. It is thus found that the median nerve consists of a definite number of nerve bundles or funiculi, which like cables are bound together. The tracts to the various muscles always occupy the same relative position in the nerve; in other words, the nerve has a definite topography or internal structure which is always the same. The surgeon will soon learn by observation the position of these various bundles, and may in time learn to dispense with the use of the electrode; but in his earlier cases it is advised that he test always each bundle after it has been isolated to determine which muscle it supplies. One may use the ordinary brain electrode, or one may have made a special electrode for this purpose. It will be found that very slight stimulation is necessary to secure response in the muscle. If a strong current is used there is danger of its spreading from one bundle to another, thereby confusing the surgeon as to which bundle of nerves he has isolated. The least strength of current necessary to produce muscular contraction should be employed. It is found that these spastic muscles respond to slighter stimulation than do normal ones. The surgeon has now produced a certain amount of paralysis of the muscles of pronation and of the flexors of the wrist and fingers. He has left, of course, untouched the ulnar nerve, which also supplies a portion of the flexors of the wrist and fingers. It may be attacked in a similar manner at a later operation if necessary.

Second, the obturator nerve. The anterior branch of the obturator supplies the gracilis, the adductor longus and all or a por-

tion of the adductor brevis. The posterior branch supplies the obturator externus, the adductor magnus, and at times the adductor brevis. Certain other muscles aid in the adduction of the thigh, notably the pectineus, which is supplied by a branch from the anterior crural, and the hamstring muscles which are supplied by branches of the sciatic. The dorsal portion of the adductor magnus frequently receives nerve supply through the great sciatic nerve. The adductor magnus is frequently divided into two distinct portions. The upper part of the anterior portion is usually quite separated from the rest of the muscle and has been termed the adductor minimus. It is therefore clear that if the anterior branch of the obturator nerve be excised a considerable degree of adduction remains in the muscles supplied by the posterior branch and by the other nerves just mentioned. If the posterior branch be excised in addition to the anterior the patient still possesses power of adduction through the pectineus, the dorsal portion of the adductor magnus, and through the hamstrings in certain positions of the thigh. Therefore in moderate degrees of spasticity the entire anterior branch of the obturator nerve is excised. In severe degrees both branches are excised. I have found it necessary only on one occasion to excise the posterior branch as well as the anterior. The technic of the operation is as follows:—an incision two or three inches in length is made from the pubic spine downward along the tendon of the adductor longus. This tendon is identified, and a blunt dissection is made by the handle of the scalpel or with the fingers along its inner margin. Dissection should never be made through muscle substance but always in the cleavage planes between the muscles. The tendon of the adductor longus is then retracted outward and the anterior branch of the obturator nerve is clearly seen running in the intermuscular fascia. If one division only of the anterior branch is observed it may be lifted upon a small hook and the blunt dissection carried proximally until the main stem of the nerve is isolated. The main stem is found to divide usually into three branches. The dry dissection is carried up to the obturator foramen. The posterior branch of the obturator can then be seen issuing from the foramen, or running backward behind the anterior fibers of the obturator externus, and behind the adductor brevis. If the anterior branch alone is to be resected the main stem is clamped by a haemostat, and is divided above the haemostat. The various

branches are then divided several inches lower as they are seen entering their respective muscles. If the posterior branch is to be resected also, it is removed in a similar manner. One or two sutures are placed in the deep fascia and the skin wound is closed.

Third, the sciatic nerve. This is attacked to overcome contracture of the hamstring muscles. The nerve is exposed without difficulty by an incision begun at the gluteal fold, and running downward for four or five inches, and placed about midway between the tuberosity of the ischium and the great trochanter. After the deep fascia has been incised the long head of the biceps muscle is identified. This muscle is then retracted inward and the dissection continued along its edge until the sciatic is encountered. On the median aspect of the nerve is found the cord which supplies the long head of the biceps, the semimembranosus, and the semitendinosus. This tract or cord is separated from the main trunk of the sciatic nerve, is lifted by a hook or an elevator, and is then dissected into its component parts. These three nerves are identified by means of the electric needle. In moderate degrees of spastic contracture the nerve to the biceps and the nerve to the semimembranosus are excised completely. In severe cases of contracture the nerve to the semitendinosus is split and about one-third of it is resected. The surgeon therefore in the first instance, leaves intact the short head of the biceps and all of the semitendinosus, and in the latter instance the short head of the biceps and on the median side the greater part of the semitendinosus. These two muscles are sufficient to secure active flexion of the knee, but their united power is not sufficient to overcome the extensor muscles of the thigh.

Fourth, the internal popliteal. Operation is made to correct pes equinus or pes equino-varus. This nerve is exposed in the center of the popliteal space. Here it lies only superficially and is easily approached. Blood vessels and other structures lie deeper. The nerve is lifted from the wound and placed across a grooved director. It is well freed upward and downward from surrounding tissue. The first branch seen to be coming from the nerve leaves on the internal and posterior aspect and immediately pursues a superficial course. This is the sensory branch called the nervus cutaneus surae medialis or the tibialis communicans. The next two nerves to leave the main trunk are the nerves to the

outer and inner heads of the gastrocnemius muscle. Running beside these two nerves is the nerve to the dorsal portion of the soleus, and the nerve to the plantaris. The common tract containing these nerves lies on the dorsal or superficial aspect of the internal popliteal nerve. The ventral portion of the soleus muscle is supplied by a special tract which lies on the antero-external aspect of the nerve. The nerve to the tibialis posticus will be found on the posterior or the posteroexternal aspect. That for the flexor longus digitorum on the postero-median aspect. In moderate cases of pes equinus the two nerves to the heads of the gastrocnemius alone are resected. In slightly more severe cases a portion approximately one-half of the nerve tract to the dorsal portion of the soleus is also excised. In still more severe cases this entire tract is excised. If it is found in the severe cases that the flexor longus digitorum is materially aiding in producing the deformity a portion of its supply must also be resected. If the tendency to pes varus is marked a portion of the supply to the tibialis posticus must be taken. After the nerves have been resected the remainder of the internal popliteal nerve is droppd back into its position where it lies embedded in fat. The deep fascia is brought together by a few sutures and the skin wound is closed.

When the patient is under the full influence of the anesthetic it is usually found that all contractures which were present before operation have disappeared. In other words, the contractures were spastic contractures, and not atrophic, such as occur in infantile paralysis. This demonstrates the impropriety of the old operation of tenotomy or tendon lengthening, whereby tendons of muscles were lengthened where no actual shortening was present and an opposite deformity was produced in many cases, e. g., a pes equinus was transformed into a pes calcaneus, which is the more disabling of the two. If it is found at the time of operation that contracture of the tendons still is present then we know that real shortening has occurred, and tendon lengthening should be done in addition to the nerve resection. However, this tendon lengthening should be performed only in case the surgeon is unable by manipulation to stretch the tendon. I have not infrequently found contracture remaining during the anesthesia but I have almost invariably been able to overcome it by forcible correction.

## AFTER-TREATMENT

My method of after-treatment varies somewhat from that recommended by Stoffel. He employs starch bandages, splints, and sand bags in all cases to maintain overcorrection, and avoids the use of plaster-of-Paris. In all cases of spastic paralysis of the lower extremities in which the contractures disappear spontaneously under the influence of the anesthetic, I employ no after-fixation. If forcible correction is necessary to reduce the contracture then I fix the member in an over-corrected position in a light plaster cast for two or three weeks. If I find within a week after operation that some tendency to contracture persists in the former class of cases I may then put the member in a plaster cast, with or without the use of an anesthetic, for a short time. It is often remarkable and astonishing on observing a patient the day following the operation, to find how completely his deformities have disappeared, and how considerable a degree of active motion he has in the direction where formerly he had little or none. If the proper preliminary treatment has been employed before operation the less likely is one to require any means of fixation after operation. As soon as the wounds have healed, which is at the end of a week, the patient is gotten out of bed and is sent to the gymnasium where he receives careful instruction in muscle training and in walking. The child is hereafter encouraged to walk as much as possible without becoming fatigued. He is no longer a bed-patient unless walking is absolutely impossible for the time being.

During my early operations I handled the nerves with great gentleness, making dissection of the component parts with extreme care. I soon found that this is unnecessary. While the nerve should not be handled roughly one need not delay the operation by extremely delicate dissection. Occasionally if the surgeon abuses the sensory tracts in the nerve the patient may complain for some days after operation of some numbness or tingling in the course of the distribution of these tracts. This is more apt to be the case in the operation upon the median nerve. I have never observed it in operating on the internal popliteal nerve and but once have I seen it in operation on the median when a complete dissection was made of all the tracts of the nerve. Ordinarily one does not touch the sensory tracts. He is familiar enough

with the topography of the nerve to isolate the tracts desired with but little dissection of the remaining portion of the nerve.

The after-treatment has been mentioned. The patient may require no apparatus. If any measures are needed to correct a pes valgus or a returning inclination to pes equinus appropriate apparatus or pads in the shoes should be prescribed. In treating the upper extremity I think greater care must be exercised. It will usually be found better to apply a light cast immediately after the operation with the forearm and the hand in a position of overcorrection. Afterwards the wrist and fingers should be kept on a splint in a hyperextended position for a period of possibly three or four months. The hand should be taken from the splint frequently during the day for treatment and exercise. A little later the splint may be cut off so that free motion of the fingers is permitted while the wrist is still maintained in hyperextension. Care must be taken always to avoid over-fatigue of any of these patients. While they are encouraged to make active movement yet it must not be overdone. This is a very important note of warning.

## Indications for Operation

It is clear from what has been said that not every case of spastic paraylsis is suitable for operation. Those are the most suitable which have a fixed deformity due to contracture of one or more of the muscle groups which have been enumerated in the various operations described above, whether they be due to a cerebral or to a spinal lesion. These cases of spasticity whose members are not in any fixed position but assume first a position of flexion and then one of extension, or those patients with athetosis are not suitable for operation. However, there is one group which may be called that of mild contracture. In this a certain mild deformity is usually present but it can be voluntarily corrected, or can be readily corrected by manipulation. When the patient becomes excited the spasm and the deformity are exaggerated. This class is suitable for the Stoffel operation, but only a small portion of the nerve supply to the stronger muscle groups should be excised. The operation is contraindicated furthermore in the most severe phases of Little's disease, with diffused spasm in almost the entire body, and in progressive diseases, such as progressive multiple sclerosis, and those extreme cases of idiocy in which the

patient would never be able to walk, even if the deformities were corrected and the spasticity reduced. Hemiplegias, whether in children or in adults may often be found suitable for operation.

## Report of Cases

No. 1. R. J. Aged 7 years. Spastic paraplegia, present since birth.

February 6, 1914. Walks on toes, crosses legs in walking, and is very unstable. Operation, tenotomies of adductors, hamstrings, tendo Achillis of left leg; and Stoffel's operation on anterior branch of the obturator, and portion of the branches of the sciatic to the hamstrings, and portion of branch of the internal popliteal to gastrocnemius and soleus of right leg.

January 9, 1915. Very much improved. Walks fairly well with braces, heels come to the ground. Knees are not flexed, toes are no longer dragged.

September 23, 1916. Braces removed.

August 25, 1917. Right foot is good, toes straight, but there is slight tendency to equinus. Left foot is in marked calcaneo-cavo-valgus. Brace reapplied to left leg, to hold foot straight.

March 9, 1918. Right foot is firm on the ground with knees straight. The thighs are well apart. Good active flexion and extension of ankle. On the left side there is no adduction and no contracture at the knee but the foot is in marked calcaneo-valgus.

June 28, 1918. Operation, left foot, horizontal transverse section, and shortening of tendo-Achillis.

December 13, 1919. Left foot is solid. No lateral deformity. The heel comes to floor at the same time as the ball of the foot, with the foot in slight dorsi-flexion. Has a few degrees of active motion in the ankle. Knee is straight. Legs are well apart in walking. No tightness of adductor tendons on either side. In the right foot there is active dorsi-flexion to about 90 degrees. The entire foot rests on the floor when standing with knee extended, but when walking the toes strike the ground first and then the heel comes to the ground. She walks fairly well without any support.

RESULT. Walking very considerably improved. The tenotomy of the left tendo-Achillis led to a marked pes calcaneo-valgus which required a later operation to correct.

No. 2. E. W. Aged 5 years. Spastic hemiplegia, which followed convulsions when eight months of age.

January 26, 1914. Marked disability of right arm and right leg.

March 25, 1914. Operation, tenotomy of tendo-Achillis.

July 27, 1914. Walks well, heel comes to the ground. The right hand and fingers are moderately flexed and the thumb is adducted and flexed.

September 20, 1914. Operation on median nerve.

October 26, 1914. Active motion of elbow 55-140 degrees. Active extension of wrist to 180 degrees. Active extension of fingers to normal. Thumb remains flexed into the palm. Inability to flex fingers completely.

July 17, 1916. Active motion of elbow 45-180 degrees. Hand is fairly straight. Thumb is flexed into the palm. Inability to make complete fist. Passive supination normal, active supination about one-half normal. Walks with heel on ground and foot straight.

February 14, 1918. Foot in good position, heel on ground, walks well. Passive supination complete, active about one-half normal. Some tendency for hand to be flexed at wrist. Passive extension of fingers, wrist and thumb normal. Active extension partial. Brace advised to maintain hand in hyperextension.

January 20, 1919. Grasp is good. Wrist, fingers and thumb are held slightly flexed, and the thumb is adducted into the palm. At times she is able to extend the fingers to a straight line and the wrist almost to a straight line. Passive hyperextension of fingers. wrist and thumb are normal. Patient has benefitted by the operation but has lacked development of the extensor muscles by exercises.

RESULT. Tenotomy of tendo Achillis satisfactory. Function of the hand considerably improved, appearance of hand very greatly improved.

No. 3. F. E. Aged 13 years. Paraplegia. June 26, 1914. Was operated upon nine years ago by Dr. Willard, who did tenotomies at the hips and tenotomies of hamstrings and probably of the adductors. Able to stand with support to balance him. Can walk sideways when supported by both hands. Stands with marked back knee, pronated feet, legs far apart. Right upper extremity fairly normal, left upper extremity—cannot raise arm above head or to behind back. Triceps and biceps weak. Grasp is weak. Wrist slightly flexed. Active extension of wrist limited to 180 degrees. Thumb cannot be abducted. Distal phalanges are in hyperextension, lead-pipe spasticity of elbow. Lower extremity—slight motion, active, at hips. No active flexion of knee. Slight active extension. No motion of ankles. Tendo Achillis contractured. Marked ankle clonus, marked quadriceps clonus.

July 4, 1914. Stoffel operation on both internal popliteals. Right leg: a portion of the nerve to the soleus, all of the nerve to one head of gastrocnemius, two-thirds of nerve to other head of gastrocnemius excised. Left leg: both nerves to the gastrocnemius and two-thirds of nerve to soleus excised.

July 15, 1914. Active dorsiflexion of feet. Can walk with little support.

August 8, 1914. Discharged. Fairly good use of legs.

RESULT. Improved. Deformity removed. Good active dorsiflexion of feet secured.

No. 4. T. F. Spastic hemiplegia since birth. July 17, 1916. Operation, median nerve. Patient left the hospital at the end of several months considerably improved. He has not been heard from since.

RESULT. Considerably improved. Have been unable to follow up the case.

No. 5. W. G. Aged 12 years. Spastic hemiplegia, left side. Occurred when two and a half years old.

July 13, 1914. Raises arm only partially above head and places it behind him with difficulty. Shoulder elevated. Trapezius slightly contracted.

Biceps and triceps have fair power. Arm is pronated, and cannot be supinated beyond the mid-position. Wrist is flexed, the thumb and fingers are flexed into the palm. No active extension of wrist. No motion in fingers, except for a little additional adduction and flexion. Walks on the toes of his left foot, tendo-Achillis is contracted. There is no active motion in the ankle. Ankle clonus present. Has hollow foot and hyperextension of great toe.

November 4, 1914. Operation, left median nerve, and the internal popliteal. It was found at the time of operation that the tendo-Achillis remained in partial contracture. It was lengthened and the extensor proprius hallicus was transplanted to the head of the first metatarsal.

December 7, 1914. Hand and fingers are straight. The thumb is not flexed into the palm. Arm can be supinated only to mid-position. Brace applied to maintain extension of wrist.

September 20, 1915. Uses hand quite well. Picks things up. Has a good grasp. Carries his school bag in his hand and holds things well. Active extension of fingers almost complete. Can make a good fist. Has slight control of thumb, but it usually remains adducted into the palm. No active supination. Can extend wrist feebly when elbow is extended. Slight radial deviation of the hand. Foot in good position. Patient has been greatly benefitted by the operation. Formerly he had not the slightest use of his hand, now he uses it well for many purposes. Walking has been improved very much.

RESULT. Very marked improvement in function of hand. Marked improvement in walking.

No. 6. W. A. Aged 27 years. Spastic paralysis of right lower extremity, probably a lateral sclerosis.

July 13, 1914. Walks with very spastic gait, with knees striking together. Uses cane.

November 14, 1914. Operation, Stoffel's on anterior branch of right obturator nerve.

December 14, 1914. Walks better. Is less spastic, can actively abduct thigh a little. Has foot drop.

February 8, 1915. Spasticity has increased. Patellar reflex and ankle clonus marked. Contracture of tendo-Achillis. No active dorsiflexion of foot. Unable to lift foot from ground in walking. Weakness of flexors of thigh.

February 11, 1918. Patient has been working for some time. Walks fairly well with cane. Knee jerk is exaggerated. Can lift foot from ground in walking. Slight active and passive abduction of thigh. Good flexion of hip. Full active extension of knee.

January 26, 1920. Patient reports by letter that he is working in New York City and that he is very greatly improved.

April 12, 1920. Patient has been working as a shoemaker and has been making $26.00 a week. He walks quite well with the use of a cane and with his legs well apart. No tendency to adduction deformity, otherwise condition remains about the same.

RESULT. Operation on the obturator nerve has proved satisfactory.

No. 7. F. W. Aged 14 years. Spastic paraplegia. Fell down stairs when ten years old. Was unconscious for a time, then had diphtheria. Lameness was noted three weeks later.

January 4, 1915. Typical spastic gait. Walking on toes, crossing knees and not lifting feet from the ground.

January 27, 1915. Operation, on both anterior obturators.

March 8, 1915. Patient walks much better, with knees apart, feet flat on the ground. Feet do not drag in walking.

Patient died before reporting again at clinic.

RESULT. Improved by the operation.

No. 8. C. J. Aged 23 years. Spastic hemiplegia. Resulted from bullet wound of head ten years ago.

March 20, 1915. Contracture of tendo-Achillis, pes valgus on standing, marked ankle and knee clonus.

March 24, 1915. Operation, Stoffel's on internal popliteal.

May 1, 1915. Patient states that he is much improved. Walks very much better. In good position. Is exercising the anterior leg muscles which are getting stronger. Active dorsiflexion of foot is good.

February 26, 1916. Good dorsiflexion of foot. Heel comes to ground and foot is straight. He has had excision of keloid scar in the popliteal space resulting from the old excision.

Patient died January 16, 1918.

RESULT. Greatly improved by operation.

No. 9. F. Y. Aged 15 years. Spastic hemiplegia, left side. Followed diphtheria when six years of age. Stoffel's operation by Dr. A. P. C. Ashhurst, June 13, 1914, partial excision of both nerves to the gastrocnemius and one to the soleus, excision of nerve to the pronator radii teres and partial excision nerve to flexors of hand and fingers.

February 8, 1915. Heel comes to floor in walking, but there is moderate pes valgus. Hand is still flexed and the arm is pronated, but is not so spastic as before operation.

April 12, 1915. Walks fairly well. Hand less spastic, but remains in flexed position most of the time.

April 21, 1915. Operation, Stoffel's on median nerve.

July 12, 1915. Voluntary partial extension of wrist and fingers, and partial active pronation and supination. Partial voluntary flexion of fingers, does not use her hand for anything. Patient cannot be traced. Final result not known. Immediate result was unsatisfactory as to function of hand, but it relieved the marked spasticity of the flexors of the fingers and the wrist.

RESULT. Moderate improvement.

No. 10. M. O'D. Aged 6 years. Spastic hemiplegia. Probably followed whooping-cough and convulsions when two years of age.

May 11, 1915. Walks with great difficulty. Contracture of tendo-Achillis and foot drop and pes varus. Toes alone come to the ground.

June 28, 1915. Operation, Stoffel's on popliteal nerve, excision of branches to the two heads of gastrocnemius, excision of portion of nerve to tibialis posticus.

July 6, 1915. Passive dorsiflexion well beyond 90 degrees. Heel on ground in standing and walking. Active flexion of some of the toes which was lacking before. Foot is held almost at a right angle when the stocking is put on. No varus.

February 26, 1918. When standing, foot is on floor and in good position, when walking there is a slight tendency to walk on toes. Passive dorsiflexion to 80 degrees. Active dorsiflexion incomplete. Mother states that child walks much better and is a great deal better in every way.

January 12, 1920. Mother states that she has steadily continued to improve. She walks quite well. Foot comes squarely to the floor and heel touches the ground. No lateral deformity. Fair active flexion and extension of ankle. Knee is held slightly flexed in walking but patient is able to extend it fully. No ankle clonus. No varus.

RESULT. Greatly improved. Whereas formerly she was scarcely able to walk she now walks quite well.

No. 11. E. M. Aged 14 years. Spastic hemiplegia. (Right side has been paralyzed since birth.)

June 14. 1915. Cannot raise arm fully above head. Fair power in deltoid and trapezius. Contracture of both axillary folds. Limitation of external rotation. Biceps and triceps have fair power. Wrist is held in extreme flexion of 90 degrees. No active extension, passive extension greatly limited. Arm is pronated and the fingers and thumb are flexed into the palm. Does not use her arm for any purposes. Marked equino-varus of the right foot.

July 21, 1915. Operation, Stoffel's on the right popliteal nerve and lengthening of the flexor tendon at the wrist.

October 25, 1915. Foot is in good position. Walking is much improved. Feeble active extension of wrist and fingers.

December 6, 1915. Uses right hand to dry dishes, can grasp objects feebly with thumb and fingers. Wrist and fingers remain fairly well extended. Slight active extension of fingers.

February 18, 1918. Walks quite well, toes strike ground, but heel touches when bearing weight. Wrist and fingers are flexed and cannot be fully straightened. Active extension of fingers when wrist is flexed.

February 27, 1918. Operation, Stoffel's on median nerve.

March 18, 1918. Passive hyperextension of fingers and wrist is normal. Slight active extension.

April 18, 1918. Wrist and fingers are straight. Has active extension of fingers but none of the wrist.

October 28, 1918. Hand and fingers remain extended. Normal passive hyperextension. Slight active flexion of wrist. No active flexion of fingers. Good adduction of thumb but no opposition. Walks with but slight limp with heel on the floor and no deformity of foot.

March 31, 1919. Active extension of wrist almost to a straight line. Active extension of fingers not quite complete at M. C. P. joints. Good active flexion of wrist but slight active flexion of fingers. Walks well with heel on ground.

RESULT. Walking much improved. Function of hand moderately improved. Appearance of hand very greatly improved.

No. 12. C. C. Aged 9 years. Spastic paraplegia since birth. Did not walk until six years of age.

September 12, 1914. Walks with great difficulty. Walks on toes, and crosses legs.

September 26, 1914. Operation by Dr. Ashhurst, excision of portion of anterior obturators and portion of internal popliteals to the gastrocnemius and soleus.

April 25, 1915. Walks very much better, heels come to the floor but the toes strike the ground first. Knees are flexed and thighs still slightly adducted.

September 26, 1915. Operation, Stoffel's, complete resection of nerves to both gastrocnemii and remainder of anterior obturators.

June 3, 1916. Much better but still marked spasticity of adductors and hamstrings. Heels come to the ground. Walks much better. Father states that he is improved 50%.

August 16, 1919. Walks with knees slightly apart and feet flat on the floor. Has tendency to double pes valgus. He continues steadily to improve, and is walking better all the time. Adductors are well relaxed. Knees are straight, good dorsiflexion of feet.

RESULT. Marked improvement in walking.

No. 13. C. W. Aged 12 years. Spastic diplegia since birth. Was born at seven months.

November 27, 1917. Spastic paralysis of all four extremities. Has never walked. Knees cannot be fully extended. Passive flexion of feet to right angles. Unable to walk even with crutches. Stands on toes, adductors are spastic, knees are held tightly together and can scarcely be separated. Mental condition backward.

February 6, 1917. Operation, Stoffel's, excision of nerves to both heads of gastrocnemii and portion of sciatic supply to solei.

April 12, 1917. Operation, Stoffel's, excision of both anterior obturators and of portion of sciatic supply to the hamstrings.

March 9, 1918. Remained in hospital for five months after operation taking exercises. He now walks with crutches, one foot forward at a time. Feet are flat on the floor, slight tendency to valgus. Knees are held slightly flexed, active flexion of feet to beyond right angle. Extension to about 135 degrees. Knees are well apart in walking, active and passive extension of knees only to 160 degrees.

April 27, 1918. Learning to walk better with crutches. Feet in slight calcaneo-valgus in walking. Knees are flexed and touch each other in walking. Braces applied.

RESULT. Was unable to walk before operation. Now walks fairly well with crutches.

No. 14. D. W. Aged 3 years. Spastic paraplegia since birth. Premature birth at six months. Mother in labor three or four days.

September 16, 1916. Can stand with support only. Marked right equinovalgus, left pes equinus. Stands on toes, adductors slightly spastic. Thighs can be well adducted passively. Knees can be passively extended. Eye grounds negative.

February 20, 1917. Operation, Stoffel's, on both internal popliteals.

September 1, 1917. Has improved considerably in walking. Still walks on toes. Left foot flexes almost to 90 degrees, right foot not so well. Feet are flat.

March 9, 1918. Marked equinus. Walks on toes, heels do not touch the floor. Passive dorsiflexion not to 90 degrees. Braces ordered, to be worn four months before deciding on another operation.

September 21, 1918. Walks fairly well alone, has been improving. Contracture of both tendo Achillis. Right heel touches ground in walking. Left heel does not. Requires another operation.

May 3, 1919. Able to walk with and without braces, when supported by one hand to maintain balance. Can walk without braces without assistance. No adductor spasm. Heels come to floor on walking. Moderate contracture of tendo Achillis, which can be partly overcome by stretching.

October 11, 1919. Able to walk alone. Legs and feet are in good position. Walking is a question of balance.

April 10, 1920. Patient continues to improve. Walks fairly well without braces, but with tendency to pes equinus. Is wearing braces to hold knees in extension.

June 3, 1920. Lengthening of tendo Achillis.

RESULT. Was unable to stand alone or to walk before operation. Now walks fairly well without support.

No. 15. L. V. Aged 3 years. Spastic paraplegia, which followed some illness when four months of age.

September 23, 1916. Lower extremities very spastic. Able to stand on toes when supported. Cannot walk. Mentality poor.

July 31, 1917. Operation, Stoffel's, excision of both nerves to gastrocnemeii, portion of supply to solei.

May 25, 1918. Feet are straight with no tendency to contracture of tendo Achillis. Good passive dorsiflexion but no active motion. She is able to stand without braces flat on her feet without deformity. Knees are slightly flexed. Adductor spasticity is present.

November 7, 1918. Operation, Stoffel's, excision of anterior branches of obturators, of two nerves to the biceps and one nerve to the semi-tendinosus. Dressed in plaster.

December 6, 1919. Wearing braces, walks fairly well if supported by hand. Knees are well apart but are slightly flexed. There is no contracture of the

hamstrings, the contracture is apparently in the structures of the knee joint. Fair active dorsal and plantar flexion of the feet. Feet in good position on floor.

RESULT. Was unable to walk before operation and could stand only when supported. Now walks fairly well when supported by the hand.

No. 16. J. D. Aged 5 years. Spastic paraplegia since two years of age.

September 15, 1917. Mother states that he has to be carried all the time, and never walks of his own accord. He is able to walk on his toes with great difficulty. Good abduction of thighs.

September 28, 1917. Operation, Stoffel's, on both internal popliteals.

November 3, 1917. Walks fairly well with legs well apart, with heels on floor.

November 8, 1919. Patient has steadily improved until he now walks fairly well alone with feet in good position on the floor, but with his knees slightly flexed. Has good active and passive dorsiflexion. Good passive abduction of thighs. No contracture of hamstrings. Braces applied to correct pes valgus.

RESULT. Walked with great difficulty before operation, now walks well with no deformity except slight tendency to pes valgus.

No. 17. L. S. Spastic paraplegia. March 30, 1918. Stoffel's operation on obturators.

RESULT. Was discharged from hospital improved, and has not been seen since.

No. 18. O. T. Aged 23 years. Spastic hemiplegia. Followed injury to head when eight years of age. Cerebral decompression was performed shortly after the injury, without results.

April 30, 1918. Her right upper extremity is very spastic. The fingers and thumb are flexed tightly into the palm. Her wrist is flexed. Her elbow cannot be fully extended. At times she has rather severe spasms in the muscles of the forearm which occasion considerable pain. She walks with a slight limp but the heel comes to the ground.

May 19, 1918. Operation, Stoffel's, on the right median nerve, resection of about one half of the nerve supply to all the muscles of the wrist and fingers except the F. L. P. and P. Q. and the deep head of the P. R. T., with total resection of the nerve to the superficial head of the P. R. T.

August 13, 1918. Patient has experienced marked improvement. She has good active flexion and extension of wrist against gravity. Can flex fourth and fifth fingers almost to the palm, and the middle finger half way and index finger but slightly. Good active extension of thumb. Can touch thumb to little finger. Rotation of forearm about one-half normal. She is learning to write with her right hand, and is able to shake hands. She goes in swimming and her hand remains straight. The muscles of the forearm are developing.

January 1, 1919. Patient in August of 1918 became severely ill with pneumonia. During her illness the spasticity in her arm became very marked, and her fingers and hand would become strongly flexed. She had severe attacks of pain in the muscles of the forearm, but spasm was at all times more marked

in the ulnar distribution than in the median. Following her recovery from pneumonia the spasm continued. Was still more marked in the ulnar distribution. The patient had lost practically all the improvement she had gained following her operation. She has continued to wear splints to support her arm but at one time had her hand corrected under an anesthetic and dressed in plaster for a time, but her improvement has been slow. She did not begin to get return of voluntary motion of the fingers and wrist for about six months, and she has not yet returned to her condition preceding her illness.

RESULT. This patient had marked improvement in the appearance and function of her hand following the operation, and then suffered a severe relapse which was due to an attack of pneumonia.

No. 19. H. A. Aged 5 years. Spastic diplegia since one year of age.

July 8, 1918. Neither talks nor walks. Mentality feeble. She is able to stand on her feet when supported. Knees are slightly contracted. Crosses her legs when standing. Feet are in a position of calcaneo-valgus.

July 10, 1918. Operation, Stoffel's, on anterior obturators, double subastragalar arthrodesis, and forcible extension of knees.

August 8, 1918. Discharged from hospital and walking on casts.

RESULT. Improved.

No. 20. W. L. Aged 4 years. Spastic paraplegia since eighteen months of age.

July 20, 1918. Right elbow is held flexed. Good power in biceps and triceps. Arm is pronated and there is good power in the grasp and almost normal active extension of wrist and fingers. Drags right leg in walking. Active supination 45 degrees beyond mid-position. He walks on the toes of the right foot. Slight contracture at the knee. Good adduction of thigh.

August 13, 1918. Operation, Stoffel's on internal popliteal.

May 3, 1919. Walks very much better with foot flat on the floor and does not drag toes. Active dorsiflexion of foot to normal extent. No deformity of foot. Fair function of right hand and arm.

RESULT. Fair improvement.

No. 21. C. W. Aged 9 years. Spastic paraplegia. Mental deficiency. Does not talk.

July 27, 1914. Cannot walk alone. Stands on toes with knees together.

August 19, 1918. Is learning to talk. Is able to stand when supported by hand. Contracture of both tendo-Achillis. Left pes valgus on standing.

August 28, 1918. Operation, Stoffel's, on anterior obturators, lengthening of both tendo-Achillis.

December 9, 1918. Braces have been applied, legs are in good position with thighs well apart and knees straight. Patient is learning to walk.

RESULT. Moderate improvement.

No. 22. A. S. Aged 22 years. Spastic paraplegia. Had severe paraplegia and had a Foerster operation three or four years ago. As a result of this operation she was greatly improved. Walking much better with her feet in

fair position, with rather marked adductor spasm so that her knees would rub together in walking.

January 14, 1919. Operation, Stoffel's on both anterior obturators. Patient was discharged from hospital about two months later and her walking was very greatly improved. Have been unable to follow this case since operation.

RESULT. Very much improved.

No. 23. D. M. Aged 5 years. Spastic paraplegia, congenital.

January 11, 1919. Has never walked. Is able to stand on his right leg, but not on his left. Left knee is held flexed. Both tendo-Achillis contractured. Marked double pes-valgus. Adductors not spastic. Has marked scoliosis.

January 30, 1919. Operation, Stoffel's, on both anterior obturators, both branches to gastrocnemius, and almost all of bundle to soleus. No contracture of tendo Achillis under ether. Dressed in plaster from pelvis to toes.

February 8, 1919. Lateral traction to spine begun.

August 16, 1919. Discharged from hospital, wearing spinal brace and thigh brace with lock-joint at knees. Able to walk when held by hand. Knees are flexed unless held extended by braces. Practically normal active dorsal and plantar flexion of feet.

June 3, 1920. Walks fairly well without support.

RESULT. Marked improvement.

No. 24. J. G. Spastic hemiplegia. March 22, 1919. Marked spasticity of left arm, and left leg. Able to walk only if held by hands. Walks on toes of left foot.

April 3, 1919. Operation, Stoffel's, on one popliteal.

July 5, 1919. Discharged from hospital walking very much better. Heel comes to ground. Walks without assistance.

RESULT. Marked improvement.

No. 25. A. M. Aged 26 years. Spastic paralysis, spinal. March 25, 1919. Operation on both obturators and popliteals. (Report given by a neurologist Dr. W. B. Cadawallader.) "A. M.'s paraplegia is organic in character caused by a chronic degeneration of the pyramidal tracts of the spinal cord which I think may have followed an infection, but is not syphilitic. The condition has existed for about five years and has progressed but very slowly. She is very neurotic and has had many hysterical symptoms from time to time. Her only chance will be, what you can do, such as a tenotomy—this should help her a lot."

February 23, 1920. When discharged from hospital she was greatly improved.

RESULT. This case has not been followed but showed marked improvement when last seen.*

*Feb. 8, 1921. This patient has been seen a number of times recently. She states that preceding the operation she had been unable to work for five years and scarcely able to walk for three years. She returned to work a month after leaving the hospital, and has worked steadily ever since. She walks almost as well as she ever did, except, when becoming excited, her gait becomes slightly spastic.

No. 26. T. F. Spastic paraplegia. Right arm and both legs. Followed illness when small child.

April 16, 1919. Operation, Stoffel's, on both obturators and tenotomy of left adductor. Also tenotomy of right hamstrings.

July 16, 1919. Application of cast to fractured femur.

RESULT. Case not followed.

No. 27. E. P. Spastic paralysis. Aged 9 years. March 18, 1919. Walks with spastic "scissors" gait, on toes, and with crossing of knees. Moderate spasticity. Ankle and patellar clonus marked. Both legs stiff. Can bend knees when legs are flexed on the thigh, but not if extended. No Babinski.

May 22, 1919. Operation, Stoffel's, on both obturators and popliteals.

October 11, 1919. She has been discharged. She can walk by herself only with the aid of a cane or when held by one hand.

May 8, 1920. Walks readily a half mile without assistance.

RESULT. Moderate improvement.

No. 28. G. P. Aged 7 years. Spastic paralysis. March 18, 1919. Cannot get out of bed by himself, unless very awkwardly. Feet are flexed, adductors spastic. All reflexes exaggerated. Patellar and ankle clonus. Babinski positive both sides. Walks with the aid of a cane and when supported by hand.

May 22, 1919. Operation, Stoffel's, on both obturators and both popliteals.

October 11, 1919. Discharged. Walks fairly well by himself, with feet flat on the floor and without crossing of legs.

RESULT. Marked improvement.

No. 29. S. A. Spastic paralysis. June 26, 1919. Operation, Stoffel's, on both popliteals and obturator nerve.

February 21, 1919. Discharged from hospital improved, but has not been seen since.

RESULT. Moderate improvement.

No. 30. A. S. Spastic paraplegia. July 14, 1919. Parents and three brothers and one sister living and well. Has had paraplegia for three or four years. Stoffel operation four weeks ago, excision of anterior branches of both obturators and nerves to both heads of right gastrocnemius and portion of branch to soleus.

August 11, 1919. Walks better than formerly. Heels to ground and knees slightly apart. Can abduct legs fairly well. Active dorsiflexion of right foot to beyond 90 degrees.

November 24, 1919. Heels do not quite touch ground in walking, due to holding knees flexed. Legs internally rotated. Good passive abduction of thighs.

RESULT. Moderate improvement.

No. 31. M. P. Aged 8 years. July 14, 1919. Spastic paraplegia. Premature birth (between seven and eight months). Cannot talk but is able to copy writing or printing. Able to walk with great difficulty with accelerated gait, walking on toes and crossing legs. Heels do not come to floor.

July 16, 1919. Operation, Stoffel's, on both internal popliteals and anterior obturator nerves. Wounds healed except for small spot in both popliteal incisions. Is already walking better. Referred to nose and throat specialist dispensary for examination for mutism.

December 1, 1919. Heels come to ground in walking. Legs well apart. Gait is markedly improved. Drags toes on walking. Swings legs to side on walking instead of moving them forward. Active dorsiflexion almost to right angle.

RESULT. Marked improvement.

No. 32. D. B. Spastic paralysis. December 4, 1919. Operation, Stoffel's, resection of the anterior branches of both obturators, and of both nerves to the gastrocnemius, one nerve to the soleus and a portion of the nerve to the right tibialis posticus.

Child was able to stand and to walk when held by the hand but she stood



on extreme tiptoes with the right foot slightly inverted and the left foot slightly everted. At times her knees would strike together. Mentality seems fair. Her thighs could be separated about one half normal.

December 6, 1919. Good active dorsiflexion of left foot to beyond right ankle and of right foot to about right angle. Good active plantar flexion.

February 23, 1920. Pads have been placed in her shoes to correct the tendency of pes valgus. She walks quite well without assistance. Heels on floor, knees do not strike.

RESULT. Marked improvement.

## CONCLUSION

Thirty-two cases have been operated on by the Stoffel method. They have been under observation for periods of time up to six years. No definite relapse has occurred in any. The youngest patient was three years of age, the oldest twenty-seven. Fifteen cases were congenital in origin, eleven infantile, four traumatic, and two were due to spinal degeneration in adults.

No ill results followed operation in any one. Two cases required a second operation. The operations on the popliteal nerve have been almost uniformly successful in relieving the contracture of the tendo Achillis and in enabling the patient to stand and walk with the foot firmly on the floor, and in greatly improving the gait. The operations on the obturator nerve have in all instances corrected the adductor spasticity, which in most of them interfered greatly with walking. The results of the operations on the sciatic nerve for hamstring contracture have also been good. The operations on the median nerve have in all instances lessened

the spasticity or corrected the deformity of the hand. In some instances the improvement in function of the hand was slight or negligible. In other instances it was very great. The hand is such a complex mechanism that it is more difficult to secure return of function when there is marked spasticity, and I feel that the results to be secured here are more uncertain than those to be secured in the lower extremity. The improvement is sometimes more brilliant but I do not feel so confident of it as I do of the results to be obtained in the lower extremity.

Where the patients have been of good mentality the results have always been very much better than where the patients have been backward or feeble-minded. I believe that we may always count on being able to cure any contractures that may be present whether in the upper or lower extremity, and the spasticity may be greatly relieved, but the amount of function, that is, of voluntary active motion of the member, which the patient will secure, depends upon the nature and the severity of the disease, upon the mentality of the patient, and upon the careful persistent after-treatment. In certain cases the deformity is relieved and the spasticity is improved but the patient is unable to establish voluntary control of the member. This, I take it, is possibly due to the organic nature of the disease. In such cases the cerebral control has been definitely and completely lost, either by injury to or disease of the cerebral centers or the cord. Even in such cases the patients are more or less improved by the moderation of the spasticity in the lower arc.

These methods of treatment have been applied to all spastic cases under my observation within the past six years. I believe that the Stoffel procedure is the best single operation which has thus far been proposed because it is applicable to a greater number of cases, the results obtained are more uniformly successful, the operation itself is in no way a severe one, and no ill results appear to follow it. Tendon lengthening is required in some cases and transplantation may be suitable in others; both of which may be combined with the Stoffel operation. It is not to be concluded that the Stoffel neurectomy is a panacea for spastic paralysis, nor that it is indicated in all cases. Judgment must be used in the selection of cases and in the time and application of the operation.

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Frepared by Dr. J. E. M. Thomson, Lincoln, Nebraska.

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# News Notes

## HOSPITALS FOR DISABLED VETERANS

It is estimated by the Public Health Service that 10,000 additional beds are immediately needed for the hospitalization of disabled soldiers, according to a letter transmitted by Surgeon-General Cumming to a committee of the Senate. The greatest urgency exists in the case of tuberculous and neuropsychiatric patients. On Jan. 1, 1921, there were in the hospitals operated by the Public Health Service 12,511 patients, and in other hospitals under contract 9,781 patients. At present the increase of patients in these hospitals is approximately 1,000 per month, and it is expected that before the peak is reached in 1927 or 1929, from 30,000 to 35,000 beds will be required.—Journal A. M. A.

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Dr. Arthur L. Jones has resumed the practice of Orthopaedic Surgery at 737 Schofield Building, Cleveland, Ohio.

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The Hospital for Deformities and Joint Diseases of New York City has changed the name of the corporation to The Hospital for Joint Diseases. The change dates from December 1, 1920.

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Dr. W. Barnett Owen and Dr. Robert T. Pirtle wish to announce the formation of a partnership practice limited to Orthopaedic Surgery in Suite 400 Francis Building, Louisville, Kentucky.

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The Berkshire School for Crippled Children in Pittsfield has recently been given $50,000 by the will of the late Hon. W. Murray Crane.

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Dr. John Lincoln Porter of Chicago has an interesting article on the equipment of a Hospital Orthopedic Department in the Modern Hospital for September 1920.

An interesting booklet has been received by the Journal outlining the scope and plans for orthopedic work in Los Angeles. The three organizations: The Hospital School, The Crippled Childrens Guild and The Los Angeles Foundation have been associated for the furtherance of the work. Dr. C. L. Lowman is Chief Orthopedic Surgeon and a member of the executive board.

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The nineteenth annual report of the New York State Hospital for the care of Crippled and Deformed Children, has just been received. (Dr. J. J. Nutt is chief surgeon and superintendent.)

The report shows that the Hospital has made considerable recent gain materially as well as in the amount of clinical work being done. 232 patients were treated during the year of which 89 were new. The report is freely illustrated. The fine new building has evidently added considerably to the capacity of the Hospital. At the end of the period for which the report was made, there were 174 patients in the Hospital. There is an apparent inadvertence on page 8, where it is stated that "This hospital is the first state institution of its kind in the country." It is the impression of the editor that the Minnesota State Hospital antedated the New York Hospital by about three years.

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The following is one of the post graduate courses offered at the University of Wisconsin in the Extension Department. One lecture and one clinic is given in each subject.

Dr. F. J. Gaenslen—Attending Orthopaedic Surgeon, Milwaukee Children's Hospital and Milwaukee County Hospital.

1. The Surgery of Infantile Paralysis.
2. Static Disabilities with Special Reference to Flat-foot.
3. Chronic Back Strain.
4. Chronic Lesions of the Hip Joint.
5. Tuberculosis of Bones and Joints.
6. Chronic Non-tuberculous Lesions of Bones and Joints.

# Current Orthopaedic Literature

A New Explanation for the Formation and Healing of Trophic Ulcers Following Nerve Severance.—Dr. Fritz Bruening, *Zentrablatt fur Chirurgie*, Vol. 47, No. 48, Nov. 27, 1920.

We are accustomed to the appearance of the so-called Trophic Ulcers after the severance of nerves or severe injuries. The author hopes to show that the stimulus of scar tissue to the proximal nerve end can be considered as a causative factor.

While on duty in Turkey he observed two very similar cases of gun-shot injuries of the Ischiatic nerves. These injuries had occurred many months before. Besides the muscular lameness there occured very marked trophic disturbances, in sense a venous hyperaemia with large and deep ulcers which went down to the bone. These ulcers up to this time had been resistant to all forms of treatment.

After this length of time it was barely possible to expect a functional result after nerve suture. However, he performed a nerve resection and suture. Almost immediately after the operation the trophic disturbances began to subside and in four weeks these large deep ulcers were smoothly healed. A further six months observation showed no functional result.

The result in these cases was unexplainable to the author until he read the article by Leriche in No. 29 of this journal which seemed to aid him in giving the necessary explanation.

He explains the condition as follows: Through the formation of the neuroma and pressure of the scar upon the nerve there is a stimulus from the proximal end of the severed nerve to the sympathetic which disturbs its tonus. With the operative removal of the neuroma and scar the stimulus is removed and its normal tone reappears and the trophic disturbances disappear.

The rebuilding of the nerve continuity serves the purposes that it hinders the reformation of a neuroma and dense nerve tissue and of course it gives the possibility, also, that a functional result may return.—*K. S. J. Hohlen, Lincoln, Nebraska.*

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A Rare Case of Malformation of the Toes in Both Feet. (Syndactilism and 13 toes). *By A. Stoffel.* Fortschr. d. Roengenstr Bd 26. Heft 3 S. 270.

Patient is a 19-year old healthy and well developed sailor whose disability consists in pain in the feet when walking and standing and who is not able to wear shoes without discomfort.

Upon examination is found that patient has on the right foot two normally developed little toes and two big toes the skin of which is grown together; but there are two separate nails; on the left foot there are two perfectly developed

little toes. The forefoot is on account of this abnormality very much broader than usual. The Xray shows: On the left side six apparently fully grown metatarsals and six toes with the three phalanges; on the right foot are seen five metatarsals with enlarged articulating surfaces on the first and fifth metatarsal bones for the articulation of the supernumerary toes.

Operation was performed on both feet for the removal of the toe with extirpation of the metatarsal on the left foot; and for the amputation of the little toe and removal of the lateral half of the big toe with part of the articulating surface of the metatarsal bone on the right foot.

Functional result follows the operation.

Etiologically it is of interest that the patient's father and grandfather had similar malformations.—*A. Gottlieb, M. D., San Francisco, Calif.*

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CENTRIPETAL MASSAGE OF SCAR TISSUE. *By A. Szenes.* Wiener Klin. Wochenschrift. 1919 No. 28.

By means of forcible separation of the skin surrounding the scar and of the scar tissue itself from its bony base, the author succeeds to form small folds. The separation is performed by means of the thumbs centripetally towards the centre of the scar. After two or three sittings, the scar becomes hyperaemic and slightly inflamed. Through this inflammatory oedema of the scar and surrounding tissues, the nonelastic fibrous scar becomes more yielding and soft, more folds begin to form until, finally, the scar can be lifted from its base to which it was adherrent.

This massage is not contraindicated in cases with small wounds in the centre of the scar as it frequently is found in amputation stumps; on the contrary: this procedure stimulates the wound to better healing.

Especially is this method of loosening scar applicable when bone forms the base; while upon muscles or fat as a base, the result is not as favorable, because of the mobility of the base.

Hot air exposures and passive hyperaemia artificially induced are used in conjunction with this massage treatment, which is very valuable as a preoperative measure to gain more skin for the subsequent closure of wound.—*A. Gottlieb, M. D., San Francisco, Calif.*

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ENDOTHELIOMA OF THE CAUDA EQUINA. Idris Morgan and Alan T. Roberts, *Med. J. of Australia*, Vol. 11, No. 24, p. 533.

The case described is that of a male 46 years of age whose principal complaint for the past three years had been "lumbago and sciatica." For the past 3 or 4 months he has had increasing weakness of the legs and tendency to incontinence. Diagnosis was made from the following data:

1. Incontinence of urine and feces.

2. Complete anesthesia of skin areas supplied by lost lumbar and upper sacral nerves.

3. Absence of knee jerks, plantar and ankle reflexes.

4. Complete loss of movement from ankle down—foot drop.

No X-Ray was made. Because of the progressive intensity, operation was performed, having been localized as being in the region covered by the 5th lumbar vertebra.

The laminae of the 2nd, 3rd, 4th & 5th lumbar vertebra were cut, arch removed. The dural contents seemed constricted. An incision was made in the dura and adenomatous mass easily separated from the cauda was removed and incision closed. Pathologists reported the tissue as there was early return of voluntary movements in both legs, and control of dural and visual sphincters.—*James E. M. Thomson, Lincoln, Nebr.*

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RIB GRAFTING OPERATIONS FOR THE REPAIR OF BONE DEFECTS AND THEIR END RESULTS AT LETTERMAN GENERAL HOSPITAL. San Francisco, Leo Eloesser, *Arch. Surg.*, Nov. 1920.

The authors series comprises 22 cases. This type of graft appears more appliable to skull and face plastics, where little strain is brought to bear on the graft. In the repair of large defects they are prone to refracture, as occurred in seven out of the 22 cases. They seem very viable even in the presence of suppuration when they survive more often than larger grafts. Thirteen cases were successful, six partially successful and three were failures.—*James E. M. Thomson, Lincoln, Nebr.*

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THE AFTER TREATMENT OF DISLOCATION OF THE ELBOW. Ernest T. Saeger, *Boston Med. & Surg. J.*, Nov. 4, 1920.

According to Dr. Saeger's statement there is greater tendency after injury to the elbow joint for osseous proliferation in neighboring muscles than in the trauma of any other joint. For this reason early passive motion and massage after dislocation are contra indicated.

The origin of this new bone formation is by tearing of the periosteum and the wandering proliferation of osteoblastic cells in the muscular tissue or by metaplasia of the connective tissue of the capsule or intermuscular septum.

The arm is kept immobilized or broken up under anesthesea, this long period of fixation renders the development of myositis ossificans traumatica less likely to occur.—*J. E. M. Thomson, Lincoln, Nebr.*